REMARKS

As a first preliminary matter, Applicant reminds the Examiner that we are awaiting acknowledgement by initialed PTO-1449 forms of consideration of a supplemental IDS filed on April 9, 2002.

As a second preliminary matter, Applicant does not have official acknowledgement of the receipt of the certified copy of the priority document filed June 5, 2001. Such acknowledgement is respectfully requested.

The application now stands with claims 25-45, 47-70 and 72-73. Claims 30, 31, 35, 51, and 56-57 stand withdrawn as unelected species claims. Herein claims 1-24, 46 and 71 have been cancelled without prejudice and claims 25-26, 40, 45, 47, 49, 52, 65, 70 and 72 are amended for reasons explained below.

The disclosure stands objected to due to informalities. The informalities of the specification, pointed out in section 4 of the Office Action, have been removed by amending the specification as shown in Appendices A-D. A few other typing errors have also been corrected in the specification.

The Examiner, however, has also objected to the term "ITER" used in page 47, line 4. It is submitted that "ITER" is in fact not an acronym. It designates an international project whose mission is to demonstrate the scientific and technological feasibility of fusion energy for peaceful purposes. The project is named "ITER" after a Latin word meaning "the way" (see page "What Is ITER?" found on the website http://www.iter.org/ and copied in Appendix C). Thus, it is submitted that the objection to ITER on page 7 is

overcome, and therefore Applicant respectfully requests that the objection be withdrawn as to this term.

Claims 25-29, 32-34, 36-50 and 58-73 stand rejected under 35 U.S.C. §112, first and second paragraphs, due to the terms "means for exposing the fissle material to a neutron flux..." as recited in claims 25, 26, 49 and 52 and "means for introducing the gas into the chamber..."as recited in claims 43 and 68 not being supported by the description of the invention in the specification, rendering the claims indefinite due to lack of enablement and written disclosure.

Regarding claims 25, 26, 49 and 52, in response, Applicant amended independent claims 25 and 49 to include the features from claims 46 and 71 respectively, and respectfully traverse. Claims 25 and 49 now recite a "means for cooling" instead of a "means for exposing", which is fully supported, for example, by the corresponding description of '36' on FIG. 21.

While not positively claimed (i.e. not claimed as a separate feature), however, claims 25 and 49 still mention that "whereby exposure of the fissile material to a neutron flux induces fission and the release of fission fragments into the chamber" in order to explain the function of the structure of the invention. It is well known that a nuclear system operating under critical conditions does not need any external neutron supply so that the "source or means to provide the neutron(s) necessary to create an initial fission in the fissile material" need not be further disclosed. The specification clearly indicates that the preferred operating conditions of the heating device and of the space engine are under "critical" conditions (page 6, lines 26-28 - see also claims 2, 26 and 50), which is a term

well understood by one skilled in the art that indicates how the neutron flux is produced and exposed to the fissle material.

In addition, those skilled in the art know how to design and dimension a critical fuel assembly, particularly based on the details for the design given in chapter 2 (pages 16-22) of the description of the preferred embodiments. Parameters of a typical design are exemplified in table 3, page 25.

Therefore, the problem solved by the present invention is not how to supply neutrons, which is known in the art, but rather how the reaction can be inhibited when the gas heating operation is not desired. This is achieved by inserting neutron-absorbing control rods in suitable cavities provided in a surrounding neutron reflector (see page 7, lines 22-24). Such control rods are labeled "12" in figure 19 (see page 44, lines 5-9). For these reasons, Applicant submits that the §112 rejections of claims 25 and 49 and their depending claims has been overcome, and respectfully requests that these rejections be withdrawn.

Regarding claims 43 and 68, Figure 21 and its corresponding description clearly describes how gas is delivered to the chambers or tubes. In particular, the construction of the chambers or tubes 28 in which the gas (e.g. hydrogen) is heated is described in detail on page 48, line 7 - page 50, line 11. Figure 21 shows a cross-section of the tube wall which incorporates ducts 32 providing an inlet for the gas to be heated. In the example shown, metallic claddings 30 and 31 prevent the gas from flowing out. The gas is directed to the interior 29 of the tube through the porous carbon material 33 and the slits 35 provided in the fissile material coating 34. Thus, the disclosure of this embodiment

clearly sets forth how and in what manner the gas is introduced into the chamber. Accordingly, Applicant respectfully requests that the rejection of claims 43 and 68 and their depending claims under 35 U.S.C. §112 should be withdrawn.

Claims 25, 26, 28, 29, 32, 36-38, 42-45, 49, 50, 52, 54, 55, 58, 61-63 and 68-70 stand rejected under 35 U.S.C. §102(b) as being anticipated by Pettus (U.S. 5,289,512). In response, Applicant respectfully traverses because (1) Pettus does not disclose or suggest a chamber wall coated with fissile material on a front face of the wall and (2) Pettus does not disclose or suggest a means for cooling the wall of the chamber from a rear face of the wall as recited in claims 25 and 49 as amended. Each is addressed in turn.

First, Pettus does not disclose or suggest a coating of fissle material and instead discloses that the inner core 16 of the PETTUS design has a fissionable carbide in the form of a bulk material. This is by no means "coated" on a chamber wall.

In more detail, PETTUS discloses a nuclear rocket engine wherein a propellant/coolant gas is first circulated through an outer cylindrical core 14 arranged as a particle bed reactor (PBR) where it is heated up to a temperature of about 2,500 °K (column 3, lines 15-17). This gas is collected in a plenum 22 and directed to an inner cylindrical core 16 to be further heated prior to exhaust. The inner core 16 is made of a block 48 of "highly refractory fissionable carbide" having axial passages 50 in which the heating takes place. It can also be made of an "open porosity carbide foam", and ^{242m}Am is the fissile isotope.

However, since the fuel material of the inner core 16 of the PETTUS design is merely a bulk material rather than a coating, a substantial fraction of the fragments

resulting from the fission of ^{233}U, ^{236}U or ^{242m}AM is released within the material rather than towards a chamber containing the flowing gas, which is highly inefficient and even unworkable.

In contrast, the coating of the (thin) fissile layer according to the invention as recited in claims 25 and 49 provides an excellent efficiency of the energy transfer from the fuel to the gas (see page 6, lines 19-25 of the specification). The two-dimensional arrangement of the fissile fuel minimizes the heat transfer to the support material.

In addition, the bulk material is not used to obtain large increases in temperature as is the coating in the present invention. To make it possible for the inner core 16 to withstand high operating temperature, PETTUS only relies on the use of a "highly refractory material" (column 1, lines 41-44). The suitable heat resistant materials listed by PETTUS in column 2, lines 59-60 are hafnium, tantalum, zirconium, and niobium, whose melting points are respectively 2,506 °K. 3,290 °K, 2,128 °K and 2,750 °K. Since the first core 14 is supposed to heat the propellant/coolant to a temperature near 2,500 °K (column 3, lines 15-17), the additional heating expected in the second inner core 16 is at most a few hundred degrees. Since PETTUS discloses a bulk material rather than a coating of fissle material on the rear face of a chamber wall, Applicant submits that the §102(b) rejection of claims 25 and 49 and their depending claims has been overcome, and respectfully requests withdrawal of the §102(b) rejection of these claims.

Second, PETTUS does not disclose or suggest means for cooling the wall of the chamber from a rear face thereof (as opposed to the front face which is coated with fissile material) as recited in claims 25 and 49 as amended.

Instead, PETTUS does not disclose any cooling means within the inner core 16 other than the flow of the propellant/coolant gas.

In contrast, the cooling of the support material (chamber wall) from its rear face as recited in claims 25 and 49 provides a higher nuclear heating capacity. With the combination of the coating of fissle material on the front face of the chamber wall and the cooling from the rear face of the chamber wall, extremely high temperatures of the propellant gas can be achieved (potentially up to the vicinity of 10,000 °K, see page 14, line 27 - page 15 line 3), which, in space engine applications, enables very high values of the specific impulse. Such heating cannot be obtained with PETTUS's system, and would even be considered as highly undesirable for the structural integrity of the engine.

As indicated in page 8, lines 30-31 of the application, a primary feature of the engine based on the new gas-heating device is the hot gas / cold fuel configuration. Such configuration is obtained by the two-dimensional arrangement of the fuel and by cooling the chamber wall from its rear face as claimed. Such features are not disclosed or suggested by PETTUS. For this additional reason, Applicant respectfully requests that the §102(b) rejection of claims 25 and 49 and their depending claims be withdrawn.

Additionally, according to PETTUS, the fission reaction in the inner core 16 is not critical, which is required by at least claims 26 and 50, but driven by leakage neutrons from the outer core 14 (column 3, lines 27-30). Thus, Applicant respectfully requests that the §102(b) rejection of at least claims 26 and 50 be withdrawn for this additional reason.

Claims 33, 39-41, 46-48, 50, 59, 64-66, and 71-73 stand unpatentable over PETTUS in view of Walsh (U.S. 3,778,344) and ROM (U.S. 3,202,582). In response,

Applicant first traverses by repeating the arguments above used to overcome the §102(b) rejection of claims 25 and 49. Specifically, that a fissle material coated on the front face of a chamber wall nor cooling from the rear face of the chamber wall is not disclosed or suggested by PETTUS.

Additionally, WALSH and ROM do not disclose or suggest these features either. WALSH discloses another design for a nuclear engine, and indicates that "it is desired to operate the reactor at as high a temperature as is practicable (column 1, lines 45-46). As noted by the examiner, WALSH uses hydrogen both as propellant and as coolant. There is no cooling circuit distinct from the circuit of the propellant.

Figure 2 of WALSH discloses that the coolant gas flows within the reactor core 12 through cooling channels 35 of relatively small diameter. These channels 35 are not coated with fissile material, but with a corrosion-preventive coating such as niobium carbide (column 4, lines 48-50). The fuel elements of the reactor core 12 are not described. They are understood to be conventional (bulk) fuel elements. Therefore, WALSH completely fails to disclose or suggest the coating of the fissle material and the cooling from the rear face of the chamber wall.

ROM discloses a nuclear rocket engine wherein a gaseous fissile material is introduced through an inlet tube 29 and a nozzle 26 into the central region of the reactor chamber (figure 1). A working fluid (hydrogen) cools the chamber walls 21 and is then introduced through the toroidal nozzle 32 to flow along the chamber wall (on the side facing the fuel region) to prevent contact with the fuel region. In other words, ROM teaches that a buffer region is required between the fuel and the chamber walls to provide

a sufficient temperature gradient (e.g. from 15,000 °F - about 8,600 °K - for the cavity down to 5,000 °F - about 2,750 °K for the tungsten wall, see column 5, lines 1-7). Therefore, ROM also fails to suggest the coating arrangement of the fissile material as well as the cooling of the chamber wall from its rear face.

Claims 33, 39-41, 46-48, 50, 59, 64-66, and 71-73 depend, directly or indirectly from claim 25 or 49, and therefore include all of the features of claim 25 or 49, plus additional features. Thus, for the same reasons mentioned above to overcome the §102(b) rejection of claims 25 and 49 in addition to WALSH and ROM also lacking these features as explained above, Applicant submits that this §103 rejection has also been overcome. Accordingly, Applicant respectfully requests that the §103 rejection of Claims 33, 39-41, 46-48, 50, 59, 64-66, and 71-73 be withdrawn.

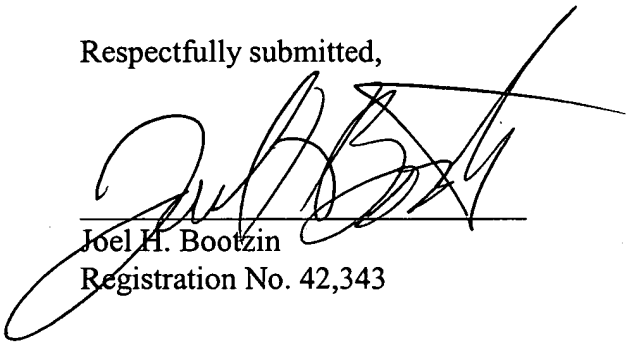
Claims 27, 34, 53 and 60 stand unpatentable over PETTUS in view of Walsh (U.S. 3,778,344), ROM (U.S. 3,202,582) and IDS document C2 by CHIKIN et al. and ETHERINGTON (Nuclear Engineer Handbook). In response, none of these references, alone or in combination, disclose or suggest a chamber wall with a coating of fissle material on the front face and cooling from the rear face as recited in claims 25 and 49. Claims 27, 34, 53 and 60 all depend from either claim 25 or 49 and therefore include these features. Therefore, the arguments for overcoming the rejection of claims 25 and 49 are repeated here that none of the references disclose these two features recited in claims 25 and 49.

Applicants note that none of these claims depend from claims rejected under ROM or WALSH, and therefore are not sure how they apply. Regardless, Applicant

repeats that neither of these two references disclose or suggest the rear/front face configuration of the chamber as recited in claims 25 and 49 either, as already argued above. For this reason, Applicant respectfully requests that the §103 rejection of claims 27, 34, 53 and 60 also be withdrawn.

For all of the reasons mention above, Applicant respectfully requests reconsideration and allowance of the pending claims. The Examiner is invited to contact the undersigned attorney to expedite prosecution.

Respectfully submitted,



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